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## THE RESPIRATORY SYSTEM OF VERTEBRATES.

*Lehrbuch der vergleichenden mikroskopischen Anatomie der Wirbeltiere.* Edited by Dr. Albert Oppel. Part v., Parietal Organ. By Dr. F. K. Studnička. Pp. vi+254. Price 8 marks. Part vi., Atmungsapparat. By Dr. Albert Oppel. Pp. x+824. (Jena: Gustav Fischer, 1905.) Price 24 marks.

IF any interruption should overtake the present rapid growth of scientific knowledge it will not be in the acquisition of new facts that the breakdown will occur, but in the systematisation of facts already acquired by present and past generations of workers. The task of systematisation, so necessary for further progress, is in the hands of the writers of text-books, but, unfortunately, the fate which presides over that world wherein men of science live and move has ordained that the financial success of a text-book is in inverse proportion to its scientific value. The general student can command with ease both author and publisher, but the specialists, for whom a text-book is a first necessity, find it almost impossible to obtain either author or publisher. It is the good fortune of those specialists who are actively investigating the finer structure of the vertebrate body to find that, thanks to the untiring industry of Prof. Oppel and the enterprise of Herr Gustav Fischer, the text-book they so much needed has now been provided for them. In bringing to a conclusion the sixth part or volume of this great task, Prof. Oppel modestly consoles himself with the hope that the work, to which he has devoted twelve years of his life without reward or fee, may prove of use to others. It is in no niggardly spirit that we in England must acknowledge the service he has rendered us.

Within the sixth volume Prof. Oppel has compressed the results of two centuries of inquiry into the minute structure of the breathing organs of vertebrate animals. The facts are drawn from more than 900 separate publications as well as from his own researches, and deal with the respiratory system of more than 500 species of vertebrate animals. A close examination of the great mass of evidence which has been thus brought together leaves one convinced that, however unlike they may seem, the gill of the fish and the lung of the mammal serve not only the same functional purpose, but are, indeed, but modifications of the self-same organ. It is now clear that in the evolution of the vertebrates there has been no development of a completely new organ of respiration. By a process which we understand but imperfectly at present, the same organ has been modified to serve the same purpose in fishes, amphibians, reptiles, birds, and mammals. The embryological investigations into the origin of the lungs of the frog by Goette, of the fowl by Kastschenko, of the human embryo by Fol, and the later researches of Weber and Buvignier, leave no room to doubt the truth of that generalisation.

Perhaps no two structures have engaged the speculative fancy of naturalists so much as the swim-bladder of fishes and the air-sacs of birds. As to the first, it cannot be said that the great number of observations which Prof. Oppel has succeeded in massing in his pages takes us perceptibly nearer a conception of the true nature and origin of the swim-bladder and its relationship to the vertebrate lung than were the naturalists of fifty years ago. A theory which regards it simply as a hydrostatic organ for permitting a fish to accommodate itself to any depth of water gives only a very incomplete explanation of its presence and structure. On the other hand, the nature of the air-sacs of birds is now almost completely understood. When the facts grouped together by Prof. Oppel are considered it becomes evident that in the vertebrate lung, be it of a frog, of a lizard, of a bird, or of a mammal, there are three distinct parts which differ in structure and in function. In no vertebrate form have these three parts become so highly specialised and distinctly separated as in birds. The three parts are:—(1) a vascular membrane covered by peculiar epithelium and puckered so as to form alveoli (the respiratory part); (2) an elastic chamber or series of chambers, capable of being enlarged and diminished on inspiration and expiration (the bellows part); (3) a series of non-collapsible tubes for conveying the air to and from the air chambers (the conducting part). In the avian lung the bellows part has become completely separated from the respiratory portion, and forms the air-sacs. Intermediate stages in the process of separation are to be seen in the lungs of reptiles. In the mammalian lung the bellows part is broken up into a series of small chambers throughout the whole organ, which form what we in England have been in the habit of calling infundibula, but which, in the more elaborate terminology of Dr. W. S. Miller, are now demarcated into vestibule, atrium, and air-sac.

The progress of our knowledge of the minute structure of the mammalian lung has been peculiarly slow. In part this has been due to the elaborate nomenclature employed. The same term has been used to designate totally different parts, and the same part has been called by several different names. Prof. Oppel has done us a great service in coordinating the terminology used by different investigators. It is clear from the manner in which Prof. Oppel discusses the question as to the nature of the epithelial covering of the gills that he finds it difficult to break away from the tradition which has come down to us from the older embryologists—that there is a profound morphological distinction between the ectodermal and endodermal layers of the embryo. From the minute manner in which he relates the matter it is evident that he quite enjoyed the prolonged scholastic discussion which was first raised by Aeby—as to whether the branching of the bronchial tree was by a process of dichotomy or monopody.

The fifth volume, which deals with our knowledge of the pineal body, and the pineal eye or parietal organ, was entrusted by Prof. Oppel to the safe hands of Dr. F. K. Studnička. That authority has not only coordinated the results contained in some three hundred papers dealing with this structure, but has added much new and valuable work of his own.

The study of structure by itself and for itself is a most unprofitable occupation, and Prof. Oppel, by including a free reference to function and development, has not only added greatly to the interest, but also to the value of these two volumes.

A. K.

## A TEXT-BOOK OF GENETICS.

*Vorlesungen uber Deszendenztheorien mit besonderer Berücksichtigung der Botanischen Seite der Frage gehalten an der Reichsuniversität zu Leiden.* By Dr. J. P. Lotsy. Erster Teil. Pp. xii+384. (Jena: Gustav Fischer, 1906.) Price 8 marks.

AS the moment is favourable, may it be suggested that the branch of science the rapid growth of which forms the occasion of Prof. Lotsy's book should now receive a distinctive name? Studies in "Experimental Evolution" or in the "Theory of Descent," strike a wrong note; for, theory apart, the physiology of heredity and variation is a definite branch of science, and if we knew nothing of evolution that science would still exist. To avoid further periphrasis, then, let us say genetics.

Prof. Lotsy's lectures are a welcome contribution to genetics. They are expository and critical rather than creative, but there is plenty of room for such a work. Since it must be admitted that to most of us facts appeal "first when we see them painted," such a presentation as this book provides should attract many who would find little to detain them in original records.

There are twenty lectures in this first part, and a second part is promised. After a philosophical introduction, which must be left to the judgment of those versed in such matters, the author proceeds to a careful discussion of the evidence for direct adaptation. Though no Lamarckian in the usual sense, he has a high respect for Lamarck's penetration and breadth of view. In this revindication of a great name, naturalists of the younger generation who have studied Lamarck's writings at first hand will probably sympathise with Prof. Lotsy. In a limited sense the modification produced by environment—biaiometamorphosis, as Prof. Lotsy calls it—is important. No botanist doubts that the forms of plants can be profoundly changed by the conditions to which they are exposed. The normal or habitual form in which we know a species is only one of these modifications. Consequently each experimental proof of the dependence of form on environment has a direct bearing on the genesis of type. But the question of *purposeful* or adaptative modification is quite distinct, and of any transmission of purposeful modification in descent there is no evidence.

The section of the book which gives it its chief value is that in which an account is provided of the new developments in genetics, especially Mendelian analysis and the experiments of de Vries. The consequences of Mendelian segregation are described with great clearness, and are illustrated by some excellent diagrams, of which one (p. 101) is striking and novel. The members of the various generations are shown in a perspective view, drawn approximately to scale, in a way which should do something to remove the supposed obscurity of these phenomena. Both the description of the facts and the critical discussion of the bearing of Mendel's discovery on the earlier or Galtonian method of calculating inheritance are especially lucid and to the point.

The weaker features of this section are such as are almost inevitable in attempts to confine a rapidly growing study within text-book limits. The relative importance of the various elements is continually changing. For example, though due stress is laid on Tschermak's fine series of cases illustrating the influence of hidden factors, or cryptomeres, Cuénot's useful exposition of the part played by double factors in the case of mice seems to have been left out. Having regard to the remarkable developments which have followed, this omission is unlucky. In the same connection it is a matter of special regret to myself that the revised and simplified account of the "walnut" combs in fowls did not reach Prof. Lotsy in time to prevent a reproduction of my former and erroneous idea in his text-book.

By all who are working at genetics the discussion of de Vries' mutations will be read with interest. Till now those remarkable observations have been regarded either with indiscriminate enthusiasm, or with still more unreasoning suspicion. But on those who know that the mutations of Œnothera are not errors of observation, and hesitate to accept them as the single key to the final mysteries of evolution, the question begins to press: What *are* those mutations? Upon this point the teaching of genetic research is clear. Before we can form a definite view as to the nature of any given mutation we must know its gametic relations to the type from which it sprang, and to the sister-mutations. So far, these relations, as expressed by the ratios in which the forms appear, seem to be almost always irregular in the Œnothera cases. Experience, however, has shown that such irregularities, as in the case of Miss Saunders' *Matthiola*, may conceal an underlying regularity which fuller analysis can reveal. For instance, we know that various individuals of a form A may give respectively an $F_2$ ratio 9A : 7B; or 3A : 1B; or all A; or 27A, 9C, 28B, and so on, and the causation or meaning of these several ratios is clear. May not such complexities be the source of the confusion which apparently besets the Œnothera cases? That is the opinion to which Prof. Lotsy inclines, and the position is for the most part unassailable as yet. All that can be positively asserted is that these mutations are forms arising discontinuously, and that their distinctions are exactly comparable with those that often appear to characterise species. But now that we understand what a medley of phenomena is included in the term "specific